1990 McGraw-Hill, Inc., Aviation Week, July 30, 1990

A model for a successful lightsat scientific project might be Goddard's Pegsat, launched this April on the first Pegasus. Pincus says the primary mission for the satellite was to gather data on temperature, acoustics, vibration and other measures of the environment for payloads on the winged booster.

But when Goddard was approached about building the spacecraft, scientists were offered the opportunity to add an experiment -- if they could do it quickly and inexpensively. The result was inclusion of a canister to release barium over Canada to study the Earth's magnetic fields. With fewer than a dozen people as the core team, Pegsat went from design through construction and ground testing in eight months at a cost of $ 1.9 million.

''It really was reminiscent of how it used to be in NASA -- actually getting your hand in the design, rolling up your sleeves and working on hardware, then going off to Canada to get data,'' Pincus said. ''On a large satellite, you get so far away from what's needed even creative people can't contribute as much as they should.''

Generally, the new generation of light satellites is thought of as spacecraft under 500 kg. (1,100 lb.). They are usually bound for low Earth orbits. Typically, they are projected to cost no more than $ 25 million, and many cost far less.

Three economists at George Mason University who recently surveyed the market put it bluntly. ''At the present time, there is much talk and little manufacturing in the industry,'' Lawrence H. Stern, Kevin J. Lacobie and Zenon X. Zygmont wrote in their report for Virginia's Center for Innovative Technology.

Donald Dalton, an economist in the U. S. Commerce Dept.'s Office of Business Analysis, counts 11 U. S. light satellite launches set for 1990. He estimates the total value of the spacecraft at $ 35 million. Dalton, who is compiling a new publication called Space Business Indicators, tallies six small ELV launches in 1990 worth $ 32 million.

The George Mason economists offer some caveats about rosy projections for lightsats. While much of the technology needed for lightsats is mature, they wrote, ''No technologies that are unique to light satellites have been identified.'' In addition, developments in terrestrial technologies can undermine schemes that might require lightsats. Advances in aircraft and remotely piloted vehicles also can have an adverse impact.

Still, the list of companies pursuing lightsat projects or studies suggests faith that the market will expand. Other entrepreneurial companies include Globesat and Intraspace in Utah; active large U. S. companies include GE, Rockwell, Hughes and Ball Aerospace (AW&ST July 23, p. 61).

Non-U. S. concerns working on small spacecraft include Matra, Israeli Aircraft Industries, Aeritalia and Fabbrica Intaliana Apparecchiature Radioelettiche SpA. (FIAR).

GRAPHIC: Illustration, TRW and Defense Systems, Inc., are building a Space Test Experiment Platform (STEP).; Illustration, Orbital Sciences Corp.'s Orbcomm subsidiary hopes to launch 20 lightsats on Pegasus winged, air-launched

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boosters. The effort to develop a low-cost network for use with pocket units and mobile terminals is one of several proposals for lightsat communications systems.; Photograph, Fairchild is commercially marketing a lightsat bus. Full-scale prototype is shown here.; Photograph, Technicians load Orbcomm-X onto a platform for vibration testing.

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LEVEL 1 - 41 OF 53 STORIES

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July 25, 1990, Wednesday, BC cycle

SECTION: Financial Report.

LENGTH: 437 words

HEADLINE: MOTOROLA <MOT.N> SEES CELLULAR STRENGTH CONTINUING

DATELINE: ROSEMONT, ILL., JULY 25, REUTER

BODY:

Motorola Inc said it expects mobile cellular telecommunications to continue to show robust growth, with 3.2 mln new subscribers added industry wide during the past 12 months.

Rick Paggeot, senior vice president, Motorola Cellular Subscriber Group, told analysts the worldwide subscriber base now is at 8.6 mln.

"We view 40 pct growth as sustainable during the next few years," Paggeot said, projecting 40 mln subscribers by the mid-1990s and 100 mln by 2000.

"This will equate to 25 pct penetration of households in major urban areas of the industrialized world," Paggeot said.

Meanwhile, Mort Topfer, senior vice president, communications sector, said Motorola's paging business continues to expand as well. He said full-scale shipments on Motorola's wristwatch pager, introduced in 1989, will begin in August.

A major paging system operator in 10 international markets, the company told analysts it has won a contract for a two-way trunked system that will serve the English Channel tunnel that will link Britain and France.

Chairman and Chief Executive Officer George Fisher declined to forecast earnings.

"At Motorola, we are looking at return on net assets, targeting double-digit growth. I would prefer to see it approaching 15 pct. It's not close to that. Right now it's around 10 to 11 pct," Fisher told analysts.

The executive also said capital spending, largely driven by semiconductor investment, will continue to rise in the near future.

Fisher said Motorola is developing Iridium, a digital global communication system expected to be fully operational by 1996 that will use 77 low-altitude satellites. He estimated the system, for which joint-venture partners are being sought, will require about 700,000 users to break even.

The first demonstration satellite will be launched in 1992.

Frederick Tucker, senior vice president, automotive and industrial electronics, said Motorola next year will test a prototype of its Intelligent Vehicle Highway System, which will provide in-vehicle navigation and route

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guidance data.

Tucker said Motorola will target its computerized navigational system at limousine and taxi drivers and delivery services. He said the device eventually might sell for 1,000 dlrs but initially would be costlier.

In answer to a question regarding the status of the patent infringement law suit between Motorola and Hitachi Ltd <HIT.T>, James Norling, Motorola semiconductor products sector president, said "We've come to a framework agreement. Details are being worked out." He added that there would be "no impact" on the company's 68030 (microprocessor) customers.

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LEVEL 1 - 42 OF 53 STORIES

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Business Week

July 23, 1990

SECTION: COVER STORY; Number 3170 ; Pg. 48

LENGTH: 3883 words

HEADLINE: AIRWAVE WARS

BYLINE: Mark Lewyn in Washington and Peter Coy in New York

HIGHLIGHT:
TOO MANY NEW TECHNOLOGIES, TOO FEW BANDS

BODY:
In 1987, United Parcel Service Inc. devised a scheme to transform its paper-and-pencil operation into the package-delivery system of the future. Drivers would no longer call in from phone booths. Instead, 55,000 UPS trucks would be fitted with radio receivers and transmitters, enabling the nation's No. 1 private package carrier to give customers up-to-the-second information about deliveries. But the master plan had a major flaw: Ham radio buffs occupied the air space that the Federal Communications Commission wanted to allocate to services such as UPS's.

And they weren't going to relinquish it without a fight. The 170,000-member American Radio Relay League galvanized ham radio operators around the country. They picketed federal buildings in Chicago, Omaha, and Cincinnati, deluged the FCC, Congress, and the White House with letters, and challenged the decision in federal court. ''If the people who are in charge of the spectrum were in charge of land usage, there would be no nature trails,'' declares Art B. Reise, a ham radio operator from New Lenox, Ill., who organized the protest. ''It would all be developed out and strip-mined.''

LIFE OR DEATH. UPS's fight with the hams is just one skirmish in a protracted high-stakes battle for the airwaves. You can't see it, hear it, feel it, or smell it, but the airwave spectrum is an indispensable highway of the Information Age. And, like land, they're not making any more of it. The part of the electromagnetic spectrum that carries communications signals is packed with everything from garage-door openers, ultrasonic denture cleaners, television, and radio to ambulance dispatchers and radio telescopes waiting hopefully for messages from extraterrestrial beings.

And every day, new users and technologies are clamoring to get their slice. Overnight, wireless networks such as cellular phones and pagers have become multibillion-dollar industries. Now, they're busting at the boundaries of their airwave allotments. The Geneva-based International Telecommunication Union, which sets guidelines for airwave use, reports that as many new frequency assignments were recorded in the past decade as in all the previous 80 years of radio communications.

Overcrowding threatens businesses that now generate more than $ 100 billion a year from the airwaves. And with the odds of finding a niche on the airwaves dwindling, it's harder to launch innovative businesses that depend on them. If

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other countries with less crowded airwaves permit new services first, their companies may be first to develop advanced radio gear -- and their economies the first to benefit from better communications.

Jammed airwaves could even mean the difference between life and death. In southern New Jersey last year, paramedics said they could not render assistance in a neighboring county because they couldn't communicate with its dispatchers. The channels were being monopolized by school bus drivers across the river in Pennsylvania who were chatting about buying lobster tails, according to a tape of their conversation sent to the FCC. The Federal Bureau of Investigation says that it has put off some investigations and scrapped others because there were no radio channels available for wiring undercover agents. ''It's really hurting our ability to do our job,'' complains James K. Kallstrom, chief of the FBI's special-operations branch in New York. ''It's a gigantic pain in the ass.''

The good news? Despite all the crowding, big portions of the airwaves remain underused, as if large patches of Manhattan were still cornfields. By adopting efficient new technology, eliminating waste, and finding a more sensible way of allocating spectrum, the nation could ease its airwave crisis. Sounds simple. But economic and political realities all but rule out a simple truce in the airwave wars. For decades, entrenched holders of airwave licenses have successfully resisted any form of redistribution. Television and radio broadcasters have grown enormously rich from their slivers of the electromagnetic spectrum. When a TV station is sold these days, the value of its FCC license can represent up to 60% of its value (chart) -- more than all the cameras and anchormen combined. With legions of lobbyists and lawyers and the powerful National Association of Broadcasters, the station owners have made sure that federal regulators don't disturb the profitable status quo. And lately, consumers worried about possible health effects of radiation from transmitters have begun fighting expanded use of the airwaves, too (page 51).

But as the crowding of the airwaves goes from bad to intolerable, more and more economists, regulators, lawmakers, and spectrum have-nots are calling for change. ''We have probably not focused sufficiently on the spectrum as an important national asset in the past, and we're going to have to change that,'' says FCC Chairman Alfred C. Sikes. Suddenly, spectrum reform is a hot topic at the FCC, the Commerce and State departments, in Congress, and at the United Nations-affiliated ITU. There has been ''more motion in the last year than in the past 10,'' says John E. Major, vice-president and general manager of Motorola Inc.'s Communications Systems Group.

FOUND MONEY? The most extreme reformers advocate airwave deregulation. They believe that the process of allocating channels should be left to the free market. The government would sell off frequencies to high bidders to do with as they pleased. As a bonus, Uncle Sam could get a badly needed shot in the treasury. A more modest option would keep the spectrum in government hands but impose hefty annual airwave-usage charges instead of the paltry licensing fees that the FCC now charges.

Not charging for the spectrum is ''a national disgrace,'' says Henry Geller, a former administrator at the Commerce Dept.'s National Telecommunications & Information Administration (NTIA) and now a communications fellow at the John & Mary Markle Foundation, a public interest group in New York. ''It's as if you stood in front of the FCC and burned hundreds of millions of dollars.''

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Apparently, the White House agrees. President Reagan favored limited spectrum auctions, and President Bush's 1990 and 1991 budgets have called for raising more than $ 3 billion over two years by selling off a small proportion of the airwaves. So far, Congress has balked.

To be sure, airwave auctions on a large scale would provoke a political firestorm. The radio spectrum is widely regarded as a national resource, like the national parks. ''Auctions mean selling off your birthright,'' says Andrew J. Schwartzman, executive director of the Media Access Project, a Washington public interest group. ''You could probably get more revenue out of the Grand Canyon if we leased it out to Nike and let them put an Air Jordan logo on the side.'' If the airwaves were left to market forces, he says, freedom of speech would suffer because only material with sufficient commercial appeal would get on the air.

Deregulation might also hinder, rather than help, technological progress, say some critics. With auctions, they say, only huge corporations could afford to buy air space to launch new services. ''If the FCC goes to auction, it would kill the little guys like me,'' says Jack Goeken, president and founder of In-Flight Phone Corp. in Oak Brook, Ill., which recently won the right to compete with the Airfone Inc. airline phone service of giant GTE Corp.

But some reform seems inevitable. Without rationalization of the current hodgepodge, the competitiveness of the U. S. economy could be at risk. ''We're at a critical time,'' says Thomas P. Stanley, chief engineer of the FCC. ''Other countries are moving ahead. When should you start planning? The answer is: immediately. And I think Congress has picked up on that.''

Indeed, a sort of airwave peace dividend has been proposed by two prominent Democratic congressmen, Representative John D. Dingell of Michigan, chairman of the Energy & Commerce Committee, and Representative Edward J. Markey of Massachusetts, chairman of the House telecommunications and finance subcommittee. Their Emerging Telecommunications Technology Act would grab 200 megahertz of spectrum now reserved for the military and other agencies and let the FCC reallocate it for civilian uses. To win Republican support, they've deleted a provision that would have banned auctioning the frequencies.

A MOBILE SURGE. Relief of airwave congestion can't come too soon for American business. In addition to UPS, dozens of companies, including IBM Corp., are outfitting their staffs with radio-communications terminals that instantly relay data on orders and inventories back to headquarters. Executives and managers are using phones, fax machines, and computers in cars, planes, and trains -- relying on the airwaves to keep in touch while they're on the go. In three years, the number of cellular phone subscribers in the U. S. quintupled, to 3.5 million by the end of 1989, overwhelming systems in cities such as Los Angeles. More services are coming. Last month, Motorola announced plans for Iridium, a satellite network that would let people call or receive calls anywhere on earth.

Faced with this mobile surge, entrenched occupants of the airwaves are straining to hold on to what they have. The military is accused of hoarding spectrum. So are long-distance phone companies, which are hanging on to bands for microwave transmission even after shifting traffic to new fiber-optic lines. And mobile communicators claim that TV broadcasters no longer need to retain control over unused swaths of spectrum, since about 60% of households now tune in via cable.

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It's a classic battle of haves vs. have-nots. Just a few years after elbowing their way onto the airwaves, cellular-phone companies are doing their best to thwart the latest newcomers, developers of personal-communications networks. PCNs are low-power, inexpensive cellular systems that could replace regular phones in offices and could also take business from existing cellular networks. Owners of cellular systems are fighting to seize control of the new technology by promising PCN service over their channels. ''I don't think we ought to run headlong into trying to find new spectrum and tossing it automatically to mobile communications,'' says Earle Mauldin, group president for BellSouth Enterprises Inc.

OLD GUARD. If airwave real estate were like the conventional kind, all this would be manageable. Somebody who wanted the space could simply buy it from somebody who had it -- at the right price, of course. Soon, free-market forces would be efficiently redistributing spectrum to reflect changes in demand and technology. But current licensees, divorced from the discipline of the free market, have little incentive to make the most efficient use of their allocated space.

The airwaves remain anything but a free market. The FCC does not allow a slot to be changed from one use to another without extensive hearings. And when a licensee wants to try a new technology -- perhaps one that would relieve airwave crowding -- the government demands elaborate hearings that can take years. In effect, the five FCC commissioners and the agency staff determine an electromagnetic industrial policy. The FCC allocates space ''in response to the private pleadings and the political pressures and the engineering knowledge of the time,'' says Robert Crandall, a Brookings Institution economist and former FCC staffer.

The process has been a mystery -- and an invitation to political maneuvering -- almost from the time Guglielmo Marconi invented his ''wireless.'' The first commercial radio stations simply homesteaded. They occupied a channel, built an audience, and gained quasi-legal rights to the slot. In a clunky way, it worked. In 1927, however, the government seized control of what had been a private market, and in 1934, it set up the FCC. While commissioners theoretically disregard politics, they depend on Congress and the White House for both their budgets and their own appointments.

Politicians caught on quickly. In 1952, an ambitious senator from Texas named Lyndon B. Johnson easily persuaded CBS Inc. to make his tiny Austin TV station the local affiliate. Nobody had to remind the network that Johnson's mentor, House Speaker Sam Rayburn, had enormous clout at the FCC. In the 1970s, when The Washington Post was digging up the Watergate scandal, allies of President Richard Nixon unsuccessfully tried to get the broadcast licenses of the Washington Post Co. by filing competing applications for them.Broadcasters also learned how to work the system. RCA Corp. founder David Sarnoff used the FCC to derail the original FM radio system, which he viewed as a threat to the infant television industry. Inventor Edwin H. Armstrong offered FM to RCA in 1933, but Sarnoff demurred because FM worked best at the same frequencies where Sarnoff was trying to establish TV. Later, Sarnoff helped persuade the FCC to move FM to its current higher band, rendering early FM sets useless.

TV broadcasters mostly have done well with the FCC ever since. For example, they persuaded the commission to keep more than half the channels on the VHF and UHF dials empty, an arrangement that limited competition for advertising

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dollars. Originally, the channels were left vacant to avoid interference between neighboring stations. But long ago, the FCC could have avoided interference -- and opened up more channels -- by requiring simple improvements in TV sets. It didn't. Recently, broadcasters pulled an about-face. Now they want the empty channels to be used -- but only by themselves for high-definition television, which requires extra bandwidth for signals that offer film-quality sharpness and audiophile sound.

The battle over HDTV promises to be the bloodiest engagement in the airwave wars, pitting powerful broadcasters against an array of opponents, including cellular-phone companies, fleet dispatchers, and police and fire departments. Broadcasters are determined to deliver HDTV over the air and are asking the FCC for an additional channel for every HDTV station. Their argument -- that the public is entitled to continue enjoying free access to TV -- has obvious political appeal. An FCC ruling, scheduled for 1993, is expected to go along with the industry request, even though engineers say it's not yet clear when it will be possible to deliver full HDTV without cable or satellite dishes.

Economists have railed against the government's spectrum-allocation policies for decades. But now, the system's inability to move new technologies to market quickly is prompting more widespread calls for reform. Take cellular phones. First conceived by AT&T Bell Labs in the 1940s, cellular could have been introduced in the early 1970s. But into the 1980s, phone companies wrangled with the FCC over how the ultralucrative cellular franchises would be allocated.

What makes the spectrum squeeze doubly frustrating is that science, left to its own devices, could do a lot to alleviate the problem. In fact, it already has: Cellular technology opened mobile phones to a mass market by creating a honeycomb of local calling ''cells'' so that the same few frequencies could be reused to carry different calls simultaneously. Now, the business is ready to switch to digital signals, which will eventually boost the capacity of cellular systems tenfold or more. That means fewer busy circuits and possibly lower rates.

Innovations in electronics, such as powerful signal-processing chips, now make it possible to use untapped higher frequencies. There's also spread-spectrum technology, a military spin-off that codes signals and splays them over a wide band at low power. A decoder at the receiving end plucks the signal out of the background noise. New York startup Millicom Inc. will test spread-spectrum PCNs in Houston and Orlando. ''All the technologies are rushing toward getting more mileage out of the frequencies that exist,'' says Shelby Bryan, Millicom's chief executive.

CRIME BUSTERS. Indeed, with enoughingenuity, technical gurus say, the airwaves have virtually unlimited capacity for every ambulance radio, cordless phone, baby monitor, and pager the public might want. But uncertainty about space on the spectrum ''thwarts investment in and development of new technology,'' says C. Michael Daley, chief executive and president of Lo-Jack Corp., a company in Needham, Mass., that sells an antitheft device that emits a radio signal to let police track stolen cars. Lack of spectrum delayed Lo-Jack's business by about five years, he says.

Fear that the U. S. will be deprived of new technologies is creating a consensus in Washington to do something about airwave gridlock. When he was named FCC chairman last year, Sikes vowed that improvement in spectrum

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management would be one of his top priorities. And the NTIA has undertaken one of the biggest studies ever on how to reform the use of the airwaves. Due out by year's end, the study is expected to recommend a raft of reforms to speed spectrum allocation.

The Dingell-Markey plan promises the quickest relief. The 200 MHz targeted by the bill would provide the capacity for thousands more cellular-phone channels or 30 channels of TV -- among many possibilities. The FCC's Sikes supports the bill, arguing that the military and other federal agencies have not used spectrum efficiently. The Pentagon objects. ''We're not spectrum hogs,'' declares Lieutenant General James S. Cassity Jr. of the Joint Chiefs of Staff. Indeed, the Pentagon has said the measure ''would adversely affect U. S. national security.'' As an incentive for cooperation, the military and other federal spectrum users should get to keep part of the money raised from auctioning space they surrender, says Janice Obuchowski, who oversees federal spectrum usage as head of NTIA.

Since airwaves don't recognize borders, there is a need for international airwave reform as well. The World Administrative Radio Conference, which meets next in Spain in 1992, will try to clear world air space for PCN-type devices, satellite-delivered HDTV, and other emerging wireless technologies. Sikes says one priority will be to establish channels for low-flying communications satellites, the type that Motorola plans for its Iridium service. The U. S. government also backs the idea of a satellite network that could broadcast radio programs around the world. Voice of America, for example, could be beamed in hi-fi -- with no possibility of jamming.

In the U. S., the most radical reform -- spectrum auctioning -- is slowly gaining support. Free-marketers say this is the best way to give the public what it really wants, because the bidder who pays the most will have more incentive to figure out the best and most efficient use of the airwaves than engineers, bureaucrats, and lawyers buried in some warren at the FCC. If a spectrum licensee were wrong, it could sell its license or change its service.

Auctions need not be as disruptive to the status quo as some critics fear, says Dale Hatfield, a consultant based in Boulder, Colo., and former acting head of the NTIA. Selling the airwaves wouldn't mean surrendering control over them, he says. Frequencies for ambulances, ham radio, educational TV or any other favored use could be exempted from auction. Affirmative action for minority and women licensees could be preserved through some form of subsidy. Another concern -- that huge corporations would monopolize the airwaves -- may also be overblown, according to Hatfield. Even the richest company could not justify buying excess spectrum and then not using it efficiently. Small rivals that could deliver competing services in less bandwidth would soon undercut the big company's prices.

Although Congress has repeatedly rejected airwave auctions, the White House still advocates selling off spectrum -- but only for specified uses. The FCC's Sikes has a similar view. He favors auctions for ''virgin'' spectrum that becomes available from the government, and he would impose restrictions on how those bands are used. A former Missouri radio station owner, Sikes is strongly against auctions for broadcast properties. He supports the traditional FCC philosophy that a broadcast license is a sacred public trust and should be awarded only after hearings are held to compare the applicants' moral standing and commitment to their communities. Sikes also is sympathetic to worries by

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broadcasters and other communications companies that radical deregulation would be akin to expropriation -- even though broadcasters don't truly own the airwaves they use.

PCN ON TV TURF. Even without massive regulatory changes, the FCC has made some important moves to ensure that spectrum is used more wisely. Sikes, for example, has been praised by reformers for insisting that future frequency allotments go to highly efficient new technologies. And the FCC has proposed a ''pioneer's preference'' that would give innovators an edge when new frequencies are doled out.

Still, the U. S. has to move ahead on spectrum or risk falling behind. Nations that haven't used their airwaves as extensively as the U. S. has can adopt new technology faster because they have more bandwidth available. Britain has taken the lead in new mobile communications such as PCN by making room on turf once reserved for TV. Canada charges a service fee for spectrum use, and Japan is seeking to clear more room in its crowded spectrum for digital wireless phones this year. New Zealand has gone the furthest. It plans to auction off the entire spectrum above 1,000 MHz, which in that small island nation is mostly unused.

Few people advocate a blanket auction of the entire spectrum, and even fewer think such a thing could ever happen in the U. S. Gradual steps, such as opening portions of the government's spectrum to free-market forces, are likely. In any case, the need for some relief is clear. Otherwise, American business won't have the air it needs to grow.

SOME POSSIBLE SOLUTIONS TO THE AIRWAVE CRISIS
-- Auction portions of the spectrum. Allow buyers to use channels as they see fit
-- Auction portions of the spectrum but designate what they must be used for
-- Lease portions of the spectrum for limited periods so they can be reclaimed for government purposes or reallocated to other civilian uses
-- Charge fees for use of the spectrum to raise money and discourage licensees from letting capacity go unused
-- Award licenses by comparative hearings, as is done now, but do it faster
-- Set aside blocks of spectrum for future services
-- Institute a ''pioneer's preference'' for spectrum awards to give incentives to innovators

MONEY IN THE AIR
Average sale price for radio and TV station (up to 60% of price reflects value of the license itself)

RADIO	
Both AM and FM	
1960s	$189,000
1970s	$463,000
1980s	$1.24 million
TV	
Both VHF and UHF	
1960s	$1.75 million
1970s	$5.32 million
1980s	$21.52 million

DATA: BROADCAST INVESTMENT ANALYSTS INC.

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GRAPHIC: Illustration, A WIRELESS WORLD, AIRWAVE GRIDLOCK

AM RADIO (535-1705 kilohertz) New AM radios will be able to tune in up to 1700 instead of 1600, thanks to a recent channel expansion granted this year by the FCC. The new spectrum was taken from government agencies. Still, all of AM takes up just a fifth of the space of one TV station

SHORTWAVE

(3-30 megahertz) These beams, bouncing off the ionosphere, can travel halfway around the globe. That makes them ideal for long-distance communications. Amateur radio operators, religious and government broadcasters crowd into short-wave

GADGETS

(46.6-47 megahertz and 49.6-50 megahertz) These slivers of spectrum are a virtual Tower of Babel shared by cordless phones, baby monitors, and garage-door openers. In case of interference, all have to yield to the primary user, which is the U.S. government. Baby monitors

are particularly trouble-

some because the

wireless microphones

are generally left

on all day in

babies' cribs

TELEVISION (VHF in three bands between 54 and 216 megahertz and UHF at 470-806 megahertz) Television is a wasteland of wasted spectrum, with five empty channels between every two live ones in the UHF band. Others clamoring

for that prime real estate

include police and ambulance dispatchers

and operators of fast-growing cellular systems. But broadcasters are determined to hold the space for high-definition TV

CELLULAR

(Two bands between 825 and 894 megahertz) Before 1976 an unused part of the UHF TV band, now it's overcrowded. New digital systems will boost capacity

SATELLITE (Various frequencies, between 1,000 megahertz and 60,000 megahertz) Growing use: extending mobile communications where cellular won't reach

INFRARED (10 trillion hertz) Above 60,000 megahertz, long-distance communications is still impractical. But infrared is useful for devices such as TV remote controls GRAPHICS BY RAY VELLA/BW ILLUSTRATIONS BY ROSS MACDONALD;

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Photograph, ''WE HAVE PROBABLY NOT SUFFICIENTLY FOCUSED ON THE SPECTRUM AS AN IMPORTANT NATIONAL ASSET IN THE PAST'' FCC CHAIRMAN ALFRED C. SIKES

PHOTOGRAPH BY KATHERINE LAMBERT; Photograph, ''ALL THE TECHNOLOGIES ARE RUSHING TOWARD GETTING MORE MILEAGE OUT OF THE FREQUENCIES THAT EXIST'' MILLICOM CEO SHELBY BRYAN

CLAUDIO EDINGER/GAMMA-LIAISON

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LEVEL 1 - 43 OF 53 STORIES

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The Independent

July 16, 1990, Monday

SECTION: BUSINESS AND CITY PAGE; Page 23

LENGTH: 1017 words

HEADLINE: High-tech firms wage airwave war; View From Manhattan

BYLINE: By LARRY BLACK

BODY:

WALL STREET last week witnessed its biggest merger in more than a year, one involving seemingly unlikely candidates, a pair of independent local US telephone utilities.

Caught in the trough between the seven regional ''Baby Bell'' conglomerates and new wave-borne communications technologies, traditional telephone companies - even innovative ones like GTE and Contel - hardly seem to be riding the crest of the future.

Nonetheless, the $ 6.2bn (pounds 3.5m) stock- swap between the two utilities, which will create America's largest local-exchange telephone company with more than 17 million lines, was widely welcomed by financial analysts, who heralded it as the first in a spate of consolidation in the industry.

''It's a great strategic move,'' said Jack Grubman, an analyst with the Paine Webber securities firm in New York. ''Telephone access lines are vastly undervalued by investors.''

But these residential ground lines - the bread and butter of companies such as GTE and Contel - are soon to be nothing more than quaint anachronisms, if one is to believe the predictions of portable-telephone campaigners like Bruce McCaw of McCaw Cellular, America's largest mobile-phone network.

Early in the next century, at least half the phone calls made in the United States will be over wireless systems, argues Mr McCaw. The number of cellular phone subscribers in the US has quintupled in the past three years, as commuters and business people have discovered the convenience of using phones, fax machines and computers away from traditional phones.

And cheaper personal-communications network (PCN) technologies are only now being introduced in America. On the horizon there's the ultimate threat posed by Iridium, a network of low-orbit satellites planned by Motorola that will allow subscribers to communicate from anywhere on the planet with a pocket-sized handset.

If the challenge posed by the $ 100bn-a- year airborne communications industry does not appear to be rattling local-exchange phone companies, it is because their competitors are rapidly running out of airspace to offer the public.

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1990 The Independent, July 16, 1990

In America, overcrowding of the airwave spectrum is cramping the development of alternative telephone systems - making ground lines and existing cellular licences all that more valuable - and the problem seems unlikely to be resolved any time soon.

Competition for space across the spectrum, from low-power, medium-wave AM radio stations through to satellite and infrared bands, is growing fierce as new generations of electronic gadgetry come on to the market, ranging from garage-door openers and ultrasonic air humidifiers, to cot monitors and courier-dispatch systems.

At the same time unused frequencies abound, but are hoarded by established industries conscious of their value and wary of how they can be employed by upstart rivals.

The struggle over the allocation of the electromagnetic spectrum in the United States - which a cover story in the current issue of Business Week magazine calls ''the airwave wars'' - has so far been dominated by the US government and particularly the Pentagon, which controls large segments of the band.

But just as resistant to reform are powerful lobbies such as America's TV broadcasters, who have managed to keep dozens of allocated channels empty, thus avoiding competition for advertising dollars.

They continue to keep the Federal Communications Commission from reassigning coveted frequencies by promising high-definition television - which will require a wider band - using the politically potent argument that the new technology should be provided to the public free of charge rather than over cable or satellite.

Tightly-squeezed cellular companies, which were finally awarded a segment of the ultra-high-frequency TV band in 1976, argue broadcast TV now in fact needs less space because 60 per cent of viewers now watch their programmes via cable systems.

Just as vociferous in defending unused bands are the ground-line phone companies, who insist on retaining microwave transmission frequencies despite spending billions laying new fibre optic cable to handle long-distance calls.

While their strategy has not succeeded in slowing the growth of cellular competitors, it has forced them to spend on new digital technology, which increases the capacity of their existing frequencies tenfold.

And cellular licence-holders themselves are trying to use the spectrum scarcity to their advantage, opposing the efforts of their challengers, the PCN systems, to gain access to air space. Cellular operators hope to delay their entry long enough to develop competitive PCN channels of their own, just as the big telephone utilities - and indeed GTE and Contel - have done with their cellular subsidiaries.

Political initiatives are in the pipeline to alleviate the crisis; one measure before Congress would transfer 200 megaHertz now in military hands to commercial use. But distribution of the new frequencies is mired in a classic free-market debate over whether they should be allocated by the FCC on merit,

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or auctioned off to the highest bidder - potentially reinforcing the near-monopoly now enjoyed by the broadcasters and utilities.

The FCC has acknowledged the dangers of delaying reallocation, and has promised to try to clear channels for emerging technologies, such as the $ 2.3bn Iridium system, scheduled to become operational by 1993. But those developing the new technologies complain that other countries - aided by more enlightened reallocation procedures, or more determined deregulators - will steal a march on American firms, robbing innovators such as Motorola of their hard- won advances in wireless communications equipment and systems.

Britain, for example, has already become the world leader in PCN technologies by turning over broadcast bands once dedicated to TV signals.

''The fight for spectrum reform is a battle of the air innovators need to win to survive and flourish,'' said one Wall Street adviser to the cellular industry. ''Either we make room for each other, or we all suffocate.''

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LEVEL 1 - 44 OF 53 STORIES

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Industry Week

July 16, 1990

SECTION: EMERGING TECHNOLOGIES; Pg. 56

LENGTH: 76 words

HEADLINE: Global cellular phone system

BYLINE: Edited by John Teresko and Therese Walter

BODY:

By 1996 the whole world could be cellular. To do it, Motorola Inc. is planning a system of 77 satellites in low earth orbit, working together as a digital-switched communications network. "Gateway" surface facilities in various countries will link the system (called Iridium) to surface-phone networks. Motorola envisions itself as a supplier with one or more international consortiums as operators. The new business unit is in Chandler, Ariz.

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LEVEL 1 - 45 OF 53 STORIES

Copyright 1990, Network World, Inc.
Network World

July 16, 1990

SECTION: OPINIONS; Emerging Technologies; Pg. 33

LENGTH: 885 words

HEADLINE: Wireless technologies could impact users' future nets

BYLINE: By Mary Johnston-Turner, Contributing Writer

BODY:

It's time for users to start tracking wireless communications technologies and develop a wireless strategy. Except for very small aperture terminals, which competed with long-haul private lines, the wireless stars of the 1980s created new markets by giving users greater mobility than ever before.

In the 1990s, wireless technologies will continue to seek new markets. However, this time, the target may be the terrestrial local loop. If so, telecommunications managers everywhere will have to start thinking about wireless services as more than niche solutions.

Consider some of the most active wireless development projects:

Digital cellular. This new generation of cellular technology will ultimately provide 10 to 20 times the capacity of existing cellular frequencies. Potentially, the cost of cellular calls could approach that of terrestrial calls, but with greater convenience.

However, the telephones will be heavier and more expensive than existing analog cellular phones, at least for a few years. And the carriers may be unable to lower prices rapidly due to the heavy debt incurred while developing the market.

Second- and third-generation cordless telephones. Using different frequencies and lower transmission power requirements than cellular phones, these systems -- often referred to as CT2 and CT3 or personal communications networks -- are touted as being able to bring personal communications' mobility to everyone.

CT2, currently being demonstrated as a replacement for pay phones in the U.K., allows a user with a low-power personal phone to initiate calls from a limited radius around a public phone kiosk. CT3 provides full two-way communications that mimics cellular more closely for less cost.

Unfortunately, neither CT2 nor CT3 is likely to be appropriate for automotive users due to technical constraints.

Digital packet radio. With limited bandwidth and fragmented geographic coverage, digital packet radio may not be for everyone. However, if a major player underwrites a national system, the technology could provide a cost-effective alternative to dial-up transaction processing, such as that used for credit cards and automated teller machine transactions.

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Cellular carriers may explore digital packet radio within the existing cellular frequencies -- one quick way of building a national infrastructure.

Wireless private branch exchanges and local-area networks. Using the unregulated frequencies defined in Part 15 of the Federal Communications Commission rules, vendors may introduce wireless premises systems.

For older office buildings that don't have dropped ceilings, raised floors or other acceptable cable conduits, wireless customer premises equipment could be a lifesaver.

Vertical Blanking Interval and frequency-modulation subcarriers. One-way data distribution systems that ride the sidebands of television and radio broadcasts have existed for some time. They may get a new lease on life as distributed on-site processing makes the one-way transmittal of data more valuable.

Other new ventures will not so much compete with terrestrial services as create or expand existing ones:

Global cellular networks. Iridium, a 77-low orbit-satellite network planned by Motorola, Inc., will provide digital switched cellular communications around the world. Scheduled for 1994 availability, this type of system could change the way people think about global communications.

Mobile satellite systems. Low-cost, 6-in. satellite terminals to support truck, train and airplane location, dispatch, pipeline telemetry and transaction processing are poised to take off. Some industry watchers forecast that upwards of two million terminals will be in use by 1995.

Next-generation VSATs. These dishes, less than one meter in diameter, will be capable of higher data rates -- in the T-1 range -- at a much lower capital cost. Paired with shared hub stations, VSATs are now more affordable than ever.

In the future, wireless technology may encompass light modulation, with infrared replacing short-haul microwave and fluctuations in florescent lights carrying data transmission throughout a building.

Whatever the industry or application requirement, telecommunications managers should realize that wireless is soon going to be much more than a luxury service for a few executives.

For each user's organization, the economics of wireless vs. terrestrial and the timetable for implementing new systems will vary. Many of the wireless options mentioned above are still far in the future, while others are only one to three years ahead.

For most of these systems, the first user may get some significant pricing concessions and extra technical support in exchange for serving as a proving ground and development partner. Checking the field may elicit some interesting new proposals from traditional land-line carriers that are worried about losing business.

Now is the time for network managers to assess how well their current and planned applications will dovetail with wireless capabilities and availabilities.

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LEVEL 1 - 46 OF 53 STORIES

PR Newswire

July 11, 1990, Wednesday

DISTRIBUTION: TO BUSINESS DESK

LENGTH: 1109 words

HEADLINE: MOTOROLA REPORTS HIGHER SECOND QUARTER, FIRST HALF RESULTS

DATELINE: SCHAUMBURG, Ill., July 11

KEYWORD: MOTOROLA EARNINGS

BODY:

SCHAUMBURG, Ill., July 11 /PRN/ -- Motorola, Inc. (NYSE: MOT), today reported higher sales and earnings in the second quarter and first half of 1990.

Second-quarter sales rose 14 percent to $2.71 billion from $2.39 billion in the second quarter of 1989. In the first half, sales reached $5.25 billion, up from $4.56 billion a year ago.

Second-quarter earnings were $161 million, or $1.22 per share, compared with $154 million, or $1.18 per share, in the second quarter of 1989. Earnings in the first six months were $288 million, or $2.20 per share, compared with $277 million, or $2.13 per share, a year earlier.

Net margin on sales was 5.9 percent in the second quarter, compared with 6.5 percent a year ago, while in the first half, it was 5.5 percent against 6.1 percent in the prior year.

George Fisher, chairman and chief executive officer, said that while profitability in the two-way radio business was lower than last year, Motorola continued to experience a recovery in semiconductors and rapid growth in cellular telephone markets.

"Our expansion into new technologies and new geographical markets should provide a solid platform for long-term growth in sales and profits," Fisher said. "New semiconductor packaging techniques and the ability to put more functions on a single chip should enable us to develop new forms of wireless personal communications systems to serve customers anywhere from inside a building to around the world."

Fisher said, "We are confident that our efforts to improve quality and reduce cycle times will strengthen our financial position and enhance our leadership in these exciting technologies."

Gary L. Tooker, president and chief operating officer, reviewed the following second-quarter results of Motorola's major operations, compared with the year-earlier quarter:

Sales in the Communications Sector increased 9 percent and new orders rose 6 percent. Operating profits were lower because of investments in product, system and market development worldwide.

In the United States, orders increased most rapidly in radio common carrier, government and commercial markets. International order growth was led by Asia and Canada.

The sector received initial orders from East Germany's largest taxi operator for two-way radios, and from the East German Telecommunications Authority for equipment to be used in a country-wide paging system. Major paging orders also were received in Italy, Canada, Korea and Hong Kong.

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The Semiconductor Products Sector's sales rose 11 percent and new orders increased 10 percent. Operating profits were higher.

Orders increased in all major regions, led by Asia Pacific. Among market segments, the order growth rate was highest in the personal computer and communications segments.

Orders were strong across most of the product portfolio. Microprocessors, microcontrollers, gate arrays, digital signal processors, fast static random access memories (RAMs), and proprietary analog and digital devices posted gains. Orders were lower for dynamic RAMs.

In the General Systems Sector, sales advanced 44 percent and orders rose 54 percent. Operating profits increased.

Cellular telephone activity continued to expand rapidly for existing customers as well as for new systems. In Spain, a cellular system supplied by TELCEL S.A., Motorola's Spanish joint venture, went into commercial service in Madrid. Under an agreement with Hungarian Radiotelephone Ltd., Motorola will supply mobile and transportable phones in Hungary. In Japan, Nippon Idou Tsushin Co. (IDO) awarded Motorola a contract to supply a cellular system in the Tokyo-Nagoya corridor.

Motorola's digital speech coder technology was selected as the standard for Japan's next generation digital cellular technology.

Information Systems Group sales increased 2 percent and orders were up 12 percent. The group operated at a loss for the quarter. Codex announced two new digital product lines and additional network management capabilities during the quarter. Universal Data Systems reported significant increases in the high-speed dial-up modem market.

The Government Electronics Group's sales increased 2 percent and orders rose 39 percent. Operating profits were higher.

A new satellite communications business unit was formed to develop a global personal communications system called Iridium. The new system is intended to enable people to communicate by telephone anywhere on Earth using portable telephones operating as part of a satellite-based system.

In the Automotive and Industrial Electronics Group, sales declined 12 percent, reflecting softness in the U.S. auto industry, while orders were 14 percent higher. Operating profits were higher due to non-recurring gains. The impact of lower sales on operating profits was partly offset by cost reduction efforts. Manufacturing operations in Taiwan were transferred to a new facility in Elma, N.Y.

MOTOROLA, INC.

1990 Consolidated Summary of Earnings

(Dollars in millions except share figures)

	Second Quarter		Six Months	
	1990	1989	1990	1989
Net sales	$2,715	$2,385	$5,248	$4,560
Earnings before income taxes	223	214	400	384
Income taxes	62	60	112	107
Net earnings	161	154	288	277
Net earnings per share	$ 1.22	$ 1.18	$ 2.20	$ 2.13
Net margin on sales (in pct)	5.9	6.5	5.5	6.1
Return on average invested capital (in pct) (A)	10.0	10.9	--	--
Weighted average shares outstanding (in millions of shares)	131.2	129.8	130.9	129.8

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(A) -- Based on the performance of the four preceding quarters ending with June 30, 1990, and July 1, 1989.

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LEVEL 1 - 47 OF 53 STORIES

Copyright 1990 The Times Mirror Company
Los Angeles Times

July 10, 1990, Tuesday, Home Edition

SECTION: World Report; Part H; Page 4; Column 1; Foreign Desk

LENGTH: 1056 words

HEADLINE: MARKET NEWSLETTER;
EASTERN EUROPE SEEKS A GOOD CONNECTION;
NEW TECHNOLOGY AND JOINT VENTURES CAN HELP RESCUE PHONE SYSTEMS THAT ARE 30 YEARS BEHIND THE WEST, BUT IT WILL BE COSTLY.

BYLINE: By CAROL J. WILLIAMS, TIMES STAFF WRITER

DATELINE: BUDAPEST, Hungary

BODY:

Since the Iron Curtain lifted last year, East Europeans have discovered that it will take a lot more than democracy to get them in touch with the West.

Industry analysts estimate that the telecommunications network from the Baltic to the Balkans is 30 years behind Western Europe and the United States -- a gap that Britain's Telecommunications Research Center estimates will cost $350 billion over 15 years to close.

West German telecommunications minister Christian Schwarz-Schilling said late last month that it will cost $33 billion and take six years just to bring East Germany's system up to Western standards.

While the outlook thus remains bleak for the average, long-suffering East European, technological innovations and the call of an open market may mean more rapid change for well-heeled Westerners doing business in the bloc.

The busy signal between East and West is too costly for the emerging democracies to tolerate. Western diplomats say entire skyscraper projects have been scrapped because of the uncertainty of telephones for them.

It can take 10 years to get a phone installed in Czechoslovakia. The wait in Poland is twice that long. In Hungary, the Post Ministry monopoly refuses even to discuss the possibility of new hookups.

For decades, Communist rulers channeled state resources into industrial output instead of social welfare, lumping communication into the category of luxury that citizens would have to wait years for.

That created networks that are shoddy and unreliable -- an economic reality that will be harder to overcome than the political deterrents. "Multi-party" has always been the rule in telephone lines, if not in politics. Dial tones can take hours to click in. Service failures are frequent, and repairs are agonizingly slow.

Technology is coming to the rescue, at least for those who can afford it.

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1990 Los Angeles Times, July 10, 1990

Motorola Inc. has announced plans for a $2-billion network of orbiting satellites to provide cellular telephone service to remote areas of the planet, including Eastern Europe. The company estimates that its new Iridium system will expand the worldwide cellular market from about 7 million subscribers today to 100 million by the year 2000.

Seventy-seven low-orbiting satellites will direct cellular radio signals from one caller's handset to another's, without the need for new switching towers, relay stations or pole networks on which the currently exhausted services depend.

A flurry of new contracts between state-owned telecommunications departments and Western companies reflect the growing belief that the best way to improve the existing wire system is to work around it.

* US West Inc. has formed a joint venture with Hungarian Telecommunications Co., an offshoot of the Post Ministry, to create a cellular network for Budapest this fall and nationwide within three years. Motorola and Sweden's Ericksson electronics firms will provide the equipment.

* Atlanta-based Contel has joined a new, private Hungarian firm descended from the giant BHG state telecommunications manufacturer to provide radio-telephone service beginning early next year.

* Bell Atlantic Corp. and US West have won the right to form a joint-venture company with the Czechoslovak Ministry of Posts and Telecommunications to modernize that nation's phone system.

* Poland has announced plans to break the monopolies of its Post, Telegraph and Telephone companies and is currently negotiating with Siemens of West Germany, Sweden's Ericksson and Alcatel of France in hopes of establishing a cellular network for 200,000 users within the next couple of years.

* West Germany's Bundespost was able to lead the cellular push into Eastern Europe virtually overnight last fall by taking advantage of its island of proximity in West Berlin. The mobile telephone is already a fixture in the briefcases of Western business people in East Berlin.

Those working to get the new projects off the ground admit that they are aiming for the hard-currency customer.

"The demand for new phones is very big, but the number of people who can pay for them is very small," observed Tamas Ligeti, commercial manager of the Contel-Hungaria venture that expects to serve 20,000 cellular cellular users next year. Vast areas of Budapest are currently without phone service, Ligeti noted, thereby blocking new commercial ventures there.

The cost of the new mobile phones will exclude the average East European. The access fee alone -- about 80,000 forints -- is a year's pay for many Hungarians and doesn't include the price of buying or using the telephone.

The dearth of reliable service in Eastern Europe would seem to guarantee success for the new ventures. But they are far from risk-free.

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